DOCTOR
OF
PHILOSOPHY

EXTENSIBLE INTEREST MANAGEMENT FOR SCALABLE PERSISTENT DISTRIBUTED VIRTUAL ENVIRONMENTS

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Eventually there will exist virtual environments inhabited by millions, but as virtual environments grow in size and number of entities, many problems emerge. Because of these problems, increasing attention is being brought to the issue of filtering data that is not of interest to a given client. Such filtering is known as *interest management*.

This dissertation outlines a three-tiered approach to interest management. The first tier breaks the world into manageable pieces. The second tier uses the data from the first to create a protocol independent perfect match between a client's interests and the environment. The third tier, building on the second, adds protocol dependence allowing the client to receive only the data from the protocol it needs. At the same time, separating out the protocol from the core interest management can allow multiple protocols to simultaneously exist within the same environment, while using the same underlying filtering mechanism.

Results from this work have shown that it is possible to create an interest management software architecture that allows bandwidth, packets per second, and CPU time to scale dependent only on the number of entities a given client is interested in at any one time.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Modeling and Simulation

KEYWORDS: Simulation, Multicast, Interest Management, Distributed Virtual Environments, Bamboo

COMPUTER-AIDED SOFTWARE EVOLUTION BASED ON INFERRED DEPENDENCIES

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The major problem addressed by this research is how to automate parts of software evolution using dependency rules, especially for large and complex real-time embedded systems. The main topics of this study are the development of a Relational Hypergraph model (RH model) and the design of a Computer-Aided Software Evolution System (CASES). The goals of this dissertation are to explore the existing issues, to formalize software evolution, to reuse software evolution components, and to build a dependency-computing model. We have resolved parts of essential software evolution issues in the

following categories: software evolution process, software evolution traceability, software evolution description, software evolution management, and software evolution control.

The RH model can realize automated software evolution in multi-dimensional phases, such as software prototype or product demo, issue analysis, requirement analysis, specification design, module implementation, program integration, and software product implementation. Many types of software evolution objects in each phase, and dependencies among these objects have been defined to describe software evolution processes. We have developed prototypes of C4I systems to conduct and validate our results.

DoD KEY TECHNOLOGY AREAS: Command, Control, and Communications, Computing and Software, Electronic Warfare, Manpower, Personnel, and Training

KEYWORDS: Software Evolution, Hypergraph Model, Dependency Rules, Software Reuse, Software Evolution Objects, Software Evolution Processes